CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval 2014/7/22 承認者 Approver TKEDA Msayasu 提出日 Date of Report 2014/6/17
実験課題番号 Project No. 2013P0804 実験課題名 Title of experiment Development and aplication of on-beam SEOP based 3He spin filter at BL17 実験責任者名 Name of principal investigator Takayuki Oku 所属 Affiliation J-PARC Center, JAEA	装置責任者 Name of Instrument scientist Masayasu Takeda 装置名 Name of Instrument/（BL No.） SHARAKU (BL17) 利用期間 Dates of experiments 2014/03/09 – 2014/03/12

1．研究成果概要（試料の名称、組成、物理的・化学的性状を明記するとともに、実験方法、利用の結果得られた主なデータ、考察、結論、図表等を記述してください。

Outline of experimental results (experimental method and results should be reported including sample information such as composition, physical and/or chemical characteristics.

In this study, we tried to install a ^{3}He nuclear spin flip system for the in-situ SEOP, which works as a π-flipper for polarized neutrons. ^{3}He nuclear spins can be flipped by the nuclear magnetic resonance (NMR) technique. The polarization of the circularly-polarized laser must be reversed simultaneously because non-reversed laser beam reduce the polarization of spin-flipped ^{3}He. To change the polarity of the laser, a half-wavelength plate was installed. The rotation angle of the half-wavelength plate was optimized, and a polarization of 98 % was obtained for the circularly-polarized laser. The ^{3}He polarization reached 70 % and was stable over one week.

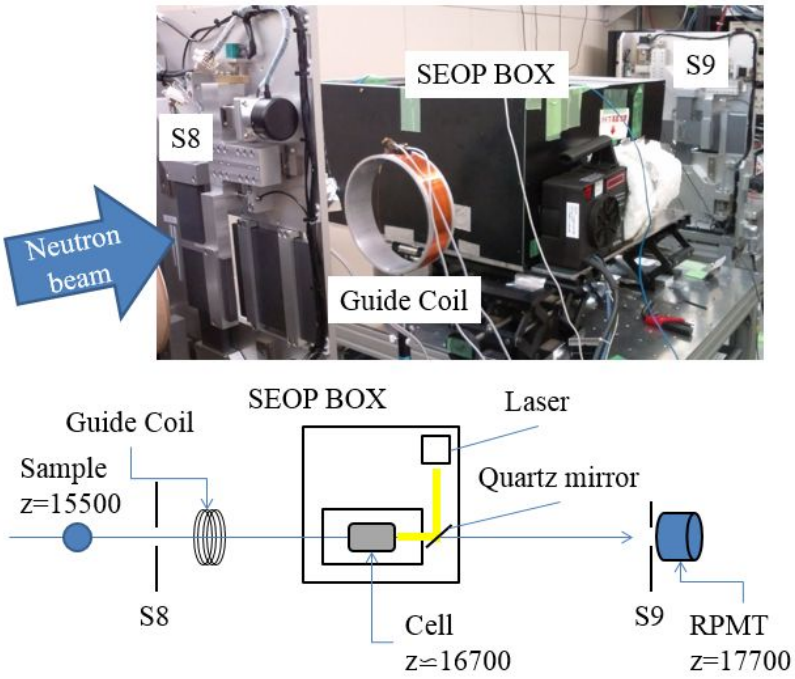

Figure 1. The picture and schematic top view of the demonstration at SHARAKU. The SEOP BOX was set between the S8 and S9.

A demonstration of the ^{3}He nuclear spin flip system was performed at the neutron reflectometer SHARAKU (BL17). Figure 1 shows a picture and schematic top view of the experiment at SHARAKU. The in-situ SEOP including the ^{3}He nuclear spin flip system (SEOP box) was set between the S8 and S9, which used as a neutron spin analyzer. A ^{3}He filter cell, which is set in the SEOP box, was placed at 1200 mm downstream of the sample position.

1．研究成果概要（つづき） Outline of experimental results (continued).

The size of the ^{3}He filter cell was 35 mm in diameter, 55 mm in length and pressure length product was 11 bar cm. A two-dimensional position sensitive detector, RPMT, was placed at z = 17700 mm.A guide coil was set between the S8 and the SEOP box to avoid depolarization of neutron spin.

A Fe/Cr multilayered thin film with the giant-magnetoregistance effect was used as a sample [1]. The ^{3}He nuclear spin flip system enabled us to control a neutron spin after the sample, and four patterns of neutron spin combinations before and after the sample (+,+), (-,-), (+,-) and (-,+) could be measured. Figure 2 shows the results of off-specular measurements with the four neutron spin combinations. The applied magnetic field to the sample was 200 Oe. Specular and off-specular reflections are shown on the Q_x = 0 and $Q_x \neq 0$, respectively. Off-specular reflections are measured around Q_z = 0.08 Å^{-1} which indicates the existence of the antiferromagnetic correlations in the sample. Scattering intensities of off-specular reflections in the spin-flip conditions of (+,-) and (-,+) are almost same as shown in Fig. 2, because both spin-flip conditions (+,-) and (-,+) have same interactions with magnetic structures in the sample. These results are consistent with ref. [1], and show that the ^{3}He nuclear spin flip system has enough performance as a π-flipper for polarized neutron. The demonstration of the ^{3}He nuclear spin flip system has been performed successfully.

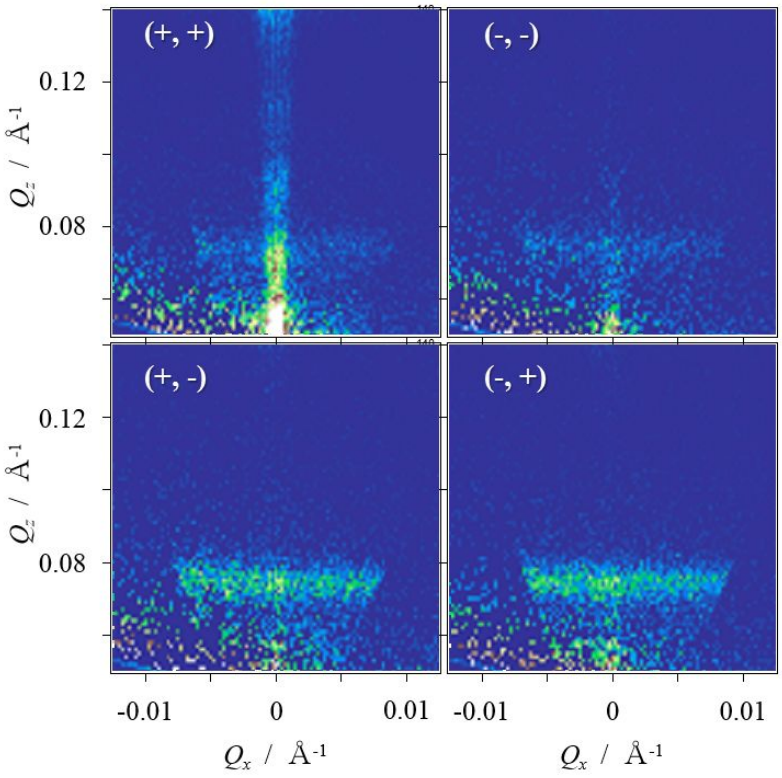

Figure 2. The results of the off-specular measurements with the four neutron spin combination patterns.

References

[1] M. Takeda, et al., Physica B **213&214**, 248 (1995).

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